Effects of Galaxy Selection Upon Lyα Absorber Identification

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Abstract. While it is possible to explain Lyα absorber counts at low redshift using gas which is associated with moderately extended galaxies [1], absorbers are often observed to be associated with galaxies at larger impact parameters from quasar lines of sight than are expected from calculated galaxy absorption cross sections in such absorber-galaxy models. However, a large fraction of absorbers is expected to arise in lines sight through galaxies which are low in luminosity and/or surface brightness, so that they are unlikely to be detected in surveys for galaxies close to quasar lines of sight. Given that it is impossible to be certain that any particular absorber has been matched to the correct galaxy, I show that it is possible to simulate plots of absorption covering factors around luminous galaxies which resemble observed plots by assuming that absorption often originates in unidentified galaxies.

Supposing that Lyα absorbers at low redshift generally arise from lines of sight through galaxies, it is easily possible to explain absorber counts when including absorption from dwarf and low surface brightness galaxies. Furthermore, it is possible to put an upper limit on the characteristic absorbing cross section of galaxies by comparing results from simulations with observed galaxy luminosity functions. For example, a galaxy with $M_B^* = -18.9$ is likely to have an absorbing radius of around 200-300 kpc assuming that absorption arises in extended disks [1]. Surveys for luminous galaxies around quasar lines of sight have found possible absorption at much larger impact parameters from such galaxies [2], [3], and surveys which include fainter galaxies [4], [5] also find large absorption covering factors at large galaxy impact parameters compared to simulation results [1]. All surveys are limited in galaxy magnitude, and few attempts have been made to search for low surface brightness galaxies around quasar lines of sight [6]. A large fraction of absorbers may originate in galaxies which are low in luminosity and/or surface brightness, so that they would not usually be detected in these surveys. Thus the absorption lines are likely to be observationally matched with other galaxies.

The simulation #10 described in [1] was repeated with the following adjustment: In order to make the number density of galaxies more realistic according to absorber counts, 31500 galaxies were simulated and placed in a cube with side length of 25 Mpc. Rather than matching each absorber with the known responsible galaxy from the simulation, the nearest galaxy was found for each absorber which satisfied some selection criteria. 'Covering factor' plots are shown in Figure 1a, which give the fraction of galaxies located in each range of impact parameter which are found to cause absorption. Here many galaxies

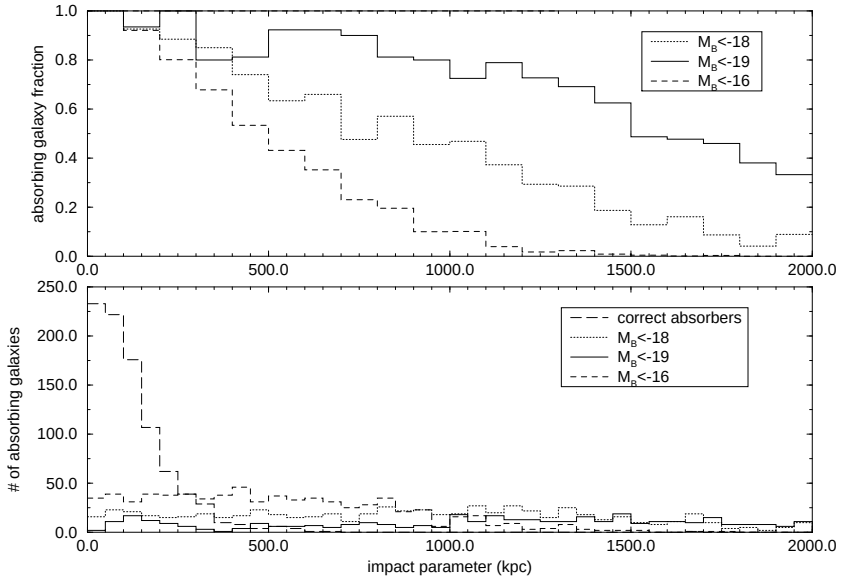

Figure 1: (a) The fraction of galaxies ($\mu_B(0) < 22$ mag arcsec^{-2}) within 400 km/s of an absorption line, which are identified as causing absorption ($> 10^{14.3}$ cm^{-2}) is plotted versus the galaxy impact parameter from the line of sight. (b) The impact parameters for the correct absorbing galaxies are plotted along with those identified as causing absorption within the given magnitude limits. No galaxy is identified within 2 Mpc of the line of sight for 2% and 10% of the absorbers for $M_B < -18$ and -19 respectively.

appear to cause absorption at larger impact parameters than those in Figure 7 of [1]. The distribution of absorbing galaxy impact parameters is shown in Figure 1b for the galaxies which are matched to absorbers according to the selection criteria and for the correct absorbing galaxies known from the simulations. Note that a galaxy which satisfies the selection criteria is often not found within 2 Mpc of a line of sight. Many absorbers are likely to arise from low surface brightness galaxies which are clustered around more luminous objects. Thus simulating accurate covering factor plots will require including clustering of galaxies in the models. When the selection procedures used to identify absorbing galaxies are taken into account the absorber-galaxy models described here may be able to produce realistic covering factor plots.

References

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